DGR
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WATERTOWN SERVICE AREA REPORT

PREPARED FOR

SIOUX RURAL WATER SYSTEM

February 2016

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Stephanie L. Moen
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DGR Project No. 802810

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February 2016

REGISTERED PROFESSIONAL ENGINEER REG. NO. 7785 DARIN L. SCHRIEVER SOUTH DAKOTA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of South Dakota. By Darin Schriever 2/5/16 Darin L. Schriever, P.E. License Number 7785 My license renewal date is July 31, 2016. Pages or sheets covered by this seal: All except Appendices

DGR Project No. 802810

DGR Engineering

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WATERTOWN SERVICE AREA REPORT

PREPARED FOR

SIOUX RURAL WATER SYSTEM

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INTRODUCTION

DGR Engineering has been retained by Sioux Rural Water System to provide a report addressing the service area near the City of Watertown. The report will provide background information on the existing distribution system and the existing water treatment plant which serves the area. The report will also address the proposed improvements project which has been previously identified. Thirdly, the report will address the potential addition of customers in the area.

Professional opinions expressed in this report are based on sound engineering principals and are made to a reasonable degree of certainty. The right is reserved to make other and further opinions and to make clarifications of the opinions if new information is received or in response to questions asked at deposition or in discovery. The biographical information for Darin Schriever, a Professional Engineer with DGR Engineering, is included in Appendix A.

BACKGROUND INFORMATION

It is common for rural water systems to construct the system to provide for certain services and not others. Sioux Rural Water System has chosen to provide water service to meet the potable water demands of domestic, small business and livestock uses in the system. It is also common for rural water systems, such as Sioux Rural Water, to build an initial system with some spare capacity to provide for increased usage and the addition of some new customers. The system is commonly built at a level which is affordable at the present time, but can be expanded in the future as needed. As new service areas develop, new customers are added and/or existing customers use more water, the system can plan for and construct improvements to meet the needs of the water customers.

A Preliminary Engineering Report (PER) was provided for Sioux Rural Water System in March of 2013. A copy of the full report is included in Appendix B. The report provides historical information for the Rural Water System and provides recommendations for improvements. An Addendum to the Preliminary Engineering Report was provided in November of 2014 and is included in Appendix C. The Addendum addresses some modifications to the original PER and the recommended improvements.

The Preliminary Engineering Report and the Addendum identified several locations in the rural distribution system which had potential low pressures during peak usage periods. Pipeline and booster improvements were identified to provide additional distribution capacity to these areas. The improvements project is intended to be bid in the Spring of 2016 with construction beginning in the Summer of 2016 and planned completion by the Spring of 2017. The proposed distribution improvements are identified in drawings included in Appendix D. The planned improvements include approximately eight miles of 8" pipeline generally south and west of Pelican Lake. This pipeline will provide additional water supply and better residual pressures to existing and potential customers in the area.

DGR Engineering has performed hydraulic modeling for rural water systems for over 30 years. The computer software used is called KY Pipe and it performs hydraulic calculations based upon instantaneous peak demand, as well as average demand. The modeling software utilizes a peak demand curve and a demand diversity method to calculate the highest flow rates expected and,

therefore, the lowest residual pressures expected during a peak water usage period. The results are identified as instantaneous peak demand flows and residual pressures. The instantaneous peak demand low pressures are theoretical only and may have never been experienced by any customer.

The software can also be used to calculate the estimated average pressures and flows for a peak day situation. These results are identified as residual pressures and flows for a 20 hour period. In addition to providing the calculated average residual pressures and flows for the distribution system, the average 20 hour period is also useful in estimating the effects upon tank levels and pumping capabilities. A 20 hour period (as opposed to a 24 hour period) is used to provide some margin for the possibility of peak day demands being higher than projected.

The hydraulic model was updated for Sioux Rural Water in early 2013 as part of the PER agreement, and the model is based upon water use in the year 2012. 2012 was notably the highest recent usage period for many systems in the region, including Sioux Rural Water. 2012 had high peak day usage and high sales volumes for the year. When performing hydraulic modeling for rural water systems, the factors included in the method of calculating the instantaneous peak demands are as important as the actual water use assigned to customers. The factors are based upon actual usage patterns of the water system and also upon long-term experience in modeling rural water systems.

WATERTOWN AREA REVIEW

A hydraulic modeling effort was performed in order to review the condition of the existing distribution system and the effect of the proposed improvements, as well as the effect upon the system with additional customers added. Two areas were reviewed specifically. The first area is generally described as the "West Side" and is the area between Lake Kampeska and Pelican Lake in Lake Township and Pelican Township. The second area considered is immediately east of Interstate 29, generally along Highway 212, or more generally described as the "East Side". The results of the modeling effort are summarized in a memo dated January 25, 2016 and is included in Appendix E.

When considering additional customers in these areas for hydraulic modeling purposes, it was assumed that the annual average monthly water use for additional customers would be 5,500 gallons per month. This is considered a very conservative approach as the actual annual average of equivalent customers in the area is 4,700 gallons per month for year 2012. For revenue projection purposes, it would be conservative to use a number less than 4,700 gallons per month because 2012 was a high sales year (about 14% higher than adjoining years). It is recommended that 4,100 gallons per month be used for an annual average for revenue projection purposes.

West Side Review

Sheets 1-3 of the memo show the existing system under instantaneous peak demand conditions. The results indicate that there can be low residual pressures experienced in the area. This is one of the primary reasons why the system intends to make improvements to the area with the proposed eight miles of 8" pipeline as previously discussed.

Sheets 4-6 display the anticipated residual pressures and flows under instantaneous peak demand conditions after the proposed improvements project is complete. This demonstrates that the improvements project will be effective in providing additional residual pressure to the area.

Sheets 7-9 indicate the residual pressures and flows for instantaneous peak demand conditions after several additional customers are added in the area and two additional minor water main improvements are complete. The additional water customers are listed on the first page of the memo in Appendix E, and they generally include the Pelican View Estates, Kaks Addition and a few small businesses in the area. The modeling results indicate that with the additional customers added to the system, acceptable residual pressures and flows can be provided to the area.

For each of the three scenarios presented above, the average 20 hour pressures and flows were also calculated. These results are displayed on Sheets 18-26 and indicate that the system has adequate pumping and distribution capacity to meet peak day demands of existing and additional customers.

<u>East Side Review</u>

The hydraulics memo addresses the distribution area on the east side of Watertown beginning with Sheet 10. Sheets 10 and 11 show the instantaneous peak demand conditions and the resulting pressures and flows for the existing system before the improvements project is completed.

Sheets 12 and 13 show the instantaneous peak demand conditions with additional customers added in the area before the improvements project is complete. The additional customers on the east side of Watertown are listed on Page 1 of the memo and generally include several small businesses in the area. The modeling results indicate that the identified additional customers can be adequately served by the existing water system.

Sheets 14 and 15 show the instantaneous peak demand conditions for the existing system with the proposed improvements project completed.

Sheets 16 and 17 show the instantaneous peak demand results with the new customers added, with minor improvements and the proposed improvements project is complete. Again, the results indicate that the additional customers can be added to the system while providing adequate pressures and flows to the system.

The average flows and pressures for a 20 hour period for the east side of Watertown are shown on Sheets 27-34. The results indicate that the system has adequate pumping and distribution capacity to meet peak day demands of existing and additional customers.

Generally speaking, the Sioux Rural Water distribution system can easily accommodate additional customers on the east side because of the previous investment made in several miles of 6-inch pipe along the east side of Interstate 90.

SIOUX WATER TREATMENT PLANT REVIEW

Sioux Rural Water System operates two water treatment plants. The south water treatment plant is called the Castlewood Water Treatment Plant and generally serves the southern and western parts of the system. The north water treatment plant is called the Sioux Water Treatment Plant and it generally serves the northern and northeastern parts of the system.

When considering the production needs of the Sioux Water Treatment Plant, more recent data was considered than that which was available at the time the original PER was completed. The PER generally contained data from 2009 to mid-2012. More recent data includes data through September 2015. Significant effort has been made over the last couple of years to control water loss, which has resulted in more water being available for delivery. Peak usage days in the spring of 2014 were similar to the peak usage days in 2012; however, the 3-day and 5-day moving averages were higher in the spring of 2014 than they were in 2012. Therefore the spring of 2014 data was used in reviewing the Sioux Water Treatment Plant capacity.

The Sioux Water Treatment Plant serves the area surrounding Watertown. The water treatment plant consists of granular media filters for iron and manganese reduction. The hydraulic capacity of the water treatment plant is 600 gallons per minute (gpm). The current raw water quality and the current effectiveness of the treatment process limit the plant capacity. The plant can produce 400 gpm with consistent good finished water quality. The plant can be operated at 450 gpm with only slight increases in finished water manganese levels. The effects of higher manganese levels are aesthetic only and are generally not problematic during high usage periods. Operated at 450 gpm over a 22 hour period, the daily treatment capacity of the Sioux Water Treatment Plant is 594,000 gallons per day. A 20 to 22 hour day is commonly used when evaluating water treatment plant capacity; this allows two to four hours per day to backwash filters and provide miscellaneous maintenance as required.

Design guidelines recommend that a water system provide finished water storage equal to or greater than an average day water demand. Recent average day demands from the Sioux WTP have been approximately 350,000 gallons per day. Total storage in the Sioux WTP service area, including reservoirs at the WTP and water towers in the distribution system, is 468,000 gallons. This exceeds the recommended amount and allows Sioux Rural Water to meet daily fluctuations in water demands and to meet multi-day high demand periods.

The 176 additional customers previously discussed in the hydraulic modeling effort represent an added water demand of approximately 32,500 gallons on an average day and approximately 93,000 gallons on a peak day. Given the current treatment capacity of 450 gpm, and given the available system storage, approximately 30-35 additional customers of the type described could be added to the system without exceeding source capacity. In order for more than 30-35 customers to be added, the source capacity would need to be increased.

Four primary alternatives can be considered for expanding source capacity for Sioux Rural Water: optimize and improve existing facilities, finding locations for wells with better water quality, adding filters and obtaining water supply from other entities. Each is discussed in more detail below.

Optimize and Improve Existing Facilities

Some improvements have been made in the last couple of years to improve the effectiveness of the current treatment process. These include filter media replacement, backwash flow rate adjustment, closer monitoring of chemical dosages, etc. Further work could potentially be done to optimize and improve the existing facilities such as: 1) a filter media study to determine if another media type would be more effective, 2) a chemical study to determine if other chemical treatments would be more effective, 3) addition of on-line instrumentation to further improve chemical control, and 4) consider the addition of a larger detention tank specifically designed for settling of iron and manganese in order to reduce the solids loading on the filters. The goal would be to attain consistent good finished water quality at treatment flow rates over 500 gpm.

New Wells with Better Water Quality

The current raw water source for the Sioux Water Treatment Plant has high levels of iron and manganese which the limits the filter capacity to 400-450 gpm and requires frequent backwash. If wells could be obtained with lower iron and manganese levels, the filters could potentially be run at a higher capacity (such as 450-550 gpm) and the filters could potentially be run for a longer time period between backwashes, both of which could increase the treatment capacity of the Sioux plant. Project cost and timeline are difficult to estimate due to the variable nature of aquifer systems. The effort could take 1 to 3 years and cost $400,000 to $700,000. Sioux Rural Water is in the beginning phase of implementing this alternative. The addition of two new wells is included in the budget of the currently funded improvements project.

Adding Filters

In previous reports, a filter addition has been identified as a potential improvement at the Sioux Water Treatment Plant. Adding two more filters would double the treatment capacity to 960,000 gallons per day. Additional wells would also be needed to increase source capacity. A filter addition would be expected to cost $1 million to $1.3 million total project cost, and the time required to complete such a project is expected to be 2 to 4 years.

Obtaining Water Supply from Other Entities

Another alternative for expanding source water capacity is to obtain a treated water supply from another entity. This could consist of purchasing water from a neighboring municipality or rural water system. Project cost would depend up location of facilities and agreements between systems. Timelines for such projects are commonly 1 to 3 years.

APPENDIX A

Darin L. Schriever, PE

Design Engineer

Education:

- Masters of Science
  Agricultural Engineering
  South Dakota State University
  1996
- Bachelors of Science
  Agricultural Engineering
  South Dakota State University
  1993

Team Role: Project Manager and Team Leader

Professional Experience:

Darin is a Project Manager and began work for DGR in November 1997. He has been actively involved in all phases of drinking water project development including feasibility studies and preliminary engineering reports, funding assistance and applications, pilot studies, preliminary design reports, final design, preparation of bidding and contract documents, writing specifications, contract administration, project observation, start-up and on-going operations assistance. Darin's professional capabilities have offered him the opportunity to lead presentations at numerous water industry seminars, technical conferences and training events.

Project planning and clear communication with the client are integral aspects to all of Mr. Schriever's projects. Planning studies regularly include capacity analysis, water quality review and analysis, supply alternatives, treatment alternatives, hydraulic modeling, budget preparation, financing alternatives, bidding and construction alternatives, and operations and maintenance considerations.

Mr. Schriever has managed a diverse array of project types for municipalities and rural systems including groundwater supply wells, treatment facilities, chemical additions, storage reservoirs, pumping stations, transmission and distribution pipelines, and control systems. He has designed numerous types of treatment systems including iron and manganese filtration, lime softening, reverse osmosis and ion exchange. Project sizes have included capacities from less than 100 gpm to over 3000 gpm and budgets from less than $50,000 to over $15,000,000.

APPENDIX B

PRELIMINARY ENGINEERING REPORT

FOR

SIOUX RURAL WATER SYSTEM

2012 WATER SYSTEM IMPROVEMENTS

March 2013

DGR Project No. 802807

PRELIMINARY ENGINEERING REPORT

FOR

SIOUX RURAL WATER SYSTEM

2012 WATER SYSTEM IMPROVEMENTS

March 2013

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By Darin Schriever
Darin L. Schriever, P.E.

South Dakota Registration No. 7785

Date April 5, 2013

REGISTERED PROFESSIONAL ENGINEER
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DARIN L.
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FOR

SIOUX RURAL WATER SYSTEM
2012 WATER SYSTEM IMPROVEMENTS

March 2013

PROJECT PLANNING AREA

A. Location

The improvements proposed to the existing facilities of the Sioux Rural Water System are shown in red in Drawing 1. The improvements include an automatic meter reading (AMR) system, and capacity improvements to the distribution and pumping systems, well field and water treatment plants.

B. Environmental Resources Present

The Sioux Rural Water system is a multi-county regional water system and includes a variety of environmental resources within its boundaries. The predominant land use is farmland and a number of rivers and small streams are present with their associated flood plains. The area provides habitat for a wide range of biological resources native to the area. The Environmental Report that has been prepared as a companion to this PER provides detailed information on all of these environmental resources.

The water system service area is an agricultural region of gently rolling terrain. The area is drained by the Big Sioux River running generally north to south through the middle of the water system. Smaller tributaries flow to the Big Sioux through the area. There is a flood plain along the Big Sioux, and water system pipelines cross the flood plain and the river in several places. The area includes numerous wetlands of varying size. The land use is divided approximately evenly between tilled farm land and agricultural pasture land. Some scattered areas are set aside as wildlife habitat, either as game reserve areas or game easements. The proposed construction does not directly impact any of these environmentally important resources.

C. Growth Areas and Population Trends

The population of the Sioux Rural Water service area is stable to slightly increasing. The areas served by the system includes most of Hamlin County and portions of the adjacent Deuel, Codington and Clark Counties. The communities of Bryant, Hazel, Hayti, Castlewood and Estelline within Hamlin County are served by the system, as are Kranzburg in Codington County, and Vienna and Naples in Clark County.

Table 1 shows the population growth for Codington and Hamlin Counties from 1990 to 2009, which is representative of the growth within the Sioux Rural Water System service area. Growth by both counties was 0.8% per year during the period and 1.2% per year for the rural and unincorporated area. This relatively modest growth in population is likely to continue into the foreseeable future and as such, will not likely significantly affect future water use projections within the service area. Water use will more likely be influenced by other factors such as livestock numbers, the type and size of individual farm operations, and persistent weather patterns.

EXISTING FACILITIES

A. Location and History

The Sioux Rural Water System is a regional water system in east central South Dakota. The water system was originally organized in the early 1970's and was constructed in 1974 through 1977. The water system had two water sources, shallow wells in the Big Sioux aquifer near Watertown (Sioux Wells) and shallow wells near Hayti (Hayti wells). The original system had no filtration treatment.

The water system has constructed a number of improvement and upgrade projects in the years after original construction. The number of water users has more than doubled. The water source has changed due to contamination of the original wells. Iron and manganese removal filtration has been added. Four new ground storage reservoirs have been constructed.

The water system presently serves 1,435 individual consumers. Bulk water service is provided to the towns of Bryant, Kranzburg, Hazel, Hayti, and Castlewood. The City of Estelline recently decided to discontinue its service contract. Among the rural connections are services to two Hutterite colonies.

The present water system has wells located on the west side of the Big Sioux River, just west of Castlewood. The water system owns approximately 220 acres of property for the well field, and controls surface activities to protect the water source. The wells pump to both the Castlewood water plant located adjacent to the well field, and to the Sioux plant located about 8 miles north.

Iron and Manganese removal filtration was added in 1991 at the Sioux plant. The design capacity of the plant is 400 gallons per minute or about 480,000 gallons per day, net of backwash. The plant experienced a peak day demand of about 568,000 gallons per day in July of 2012. Water service to Kranzburg and Hazel is included in this total.

From the Sioux plant water is pumped west to Tower E and the Tower E service area. A separate pump header pumps to the east to Booster D and ultimately to Tower G. There is a pipeline connection to Tower F from Booster D that is not presently in use.

Iron and manganese removal filtration is also provided at the Castlewood plant, constructed in 1991. The Castlewood plant has a design capacity of 750 gallons per minute or about 900,000 gallons per day net of backwash. The Castlewood plant experienced a maximum day demand in July of 2012 of 1,113,000 gallons per day. Water service to Bryant and Hayti is included in this total.

From the Castlewood plant, water is pumped west to the Kones Korner ground storage reservoir. There is a small service area near the reservoir served by a pump system at the reservoir, but most water flows by gravity from Kones to Booster C. Pumps at Booster C are sequenced to fill Tower A and Tower B.

East of Castlewood water is pumped to the Krause ground storage reservoir. From Krause water is pumped to a local service area, and to fill Tower F. Water flows by gravity from Krause to connections south of the reservoir.

Drawing 1 shows the location of all of the existing facilities as well as those that are planned for future construction as part of the current project.

B. Condition of Facilities

1. Maintenance and Water Loss:

The Sioux Rural Water System is a well maintained regional system with modern equipment. There is inadequacy in the present system to the extent that the system is operating at near full capacity in some areas, and is faced with certain increasing demand. This report considers options to improve the system to make best use of existing facilities. No issues of deferred maintenance or need for equipment replacement were identified. This report presumes that existing facilities will stay in place and continue to be used at the present capacity through the planning period for this report.

The adequacy of maintenance of the present facilities is confirmed by the low unaccounted for water percentages. Unaccounted for water includes leaks within the distribution pipeline system or inaccuracies in meter readings. Table 2 and Figure 1a show unaccounted for water since 2000. In the table, "Loss" is the difference between water produced and water sold. This amount is adjusted by subtracting known unmetered uses such as filter backwash and line flushing activities. Unaccounted for water is generally presented as a percentage of water produced and varies in Table 2 from a high of 16% in 2003 to a low of 4% in 2008. The management of the system monitors water loss and recognizes and addresses rising trends.

2. Historic Water Use:

Annual water produced and sold since 2000 is displayed in Table 2 and Figures 1a and 1b. Water use for the period is relatively flat and no clear trends were apparent for the period.

Sioux Rural Water is bounded on all sides by other rural water systems and therefore, growth due to an expansion of its service areas is not possible. Within its service area the system has experienced continued growth in the number of customers. Table 3 displays the change in the number of customers in each customer group from 2000 through 2011. The growth trend for each customer group is illustrated in Figure 2. The greatest growth percentage occurred in seasonal users with an increase from 31 to 40 during the period. Growth in the number of rural customers, the largest user group, has been relatively constant over the time period increasing from 1,072 rural customers in 2000 to 1,277 in 2011. This was an increase of 205 customers or about 19 new customers per year.

3. Water Supply:

The water needs for the system are provided from the two water treatment plants, Castlewood and Sioux. Both plants are supplied by shallow wells at the Castlewood water treatment plant. Both plants remove iron and manganese from the raw water and disinfect the finished water with chlorine.

a. Castlewood Well Field: The Castlewood well field currently includes six(6) shallow wells finished in the Big Sioux Aquifer. The designation for each well and corresponding capacity in gallons per minute is as follows:

Well S1	315 gpm
Well S2	305 gpm
Well S3	445 gpm
Well S4	305 gpm
Well C1	210 gpm
Well C2	250 gpm

Total well capacity is 1,830 gpm. Firm Capacity, the capacity with the largest well out of service, is 1,385 gpm. At 1,385 gpm, the wells can produce 1,662,000 gallons in a 20 hour day which is very close to the combined peak day for the two water treatment plants recorded in 2012. Also, the Firm Capacity of 1,385 gpm would be only marginally able to supply the two plants operating as they have in 2012 at 900 gpm and 500 gpm. We therefore recommend that additional wells be developed to match the proposed treatment capacity discussed later in this report.

b. Castlewood Water Source: The Castlewood water treatment plant is located approximately one mile west of the City of Castlewood. The plant is supplied by the Castlewood Well Field and its treatment process utilizes the oxidation of iron and manganese followed by filtration to remove iron and manganese from the raw water supply. Raw water entering the plant passes through a 5' x 5' induced draft aerator with a rated capacity of 750 gpm at 30 gpm per square foot. After aeration the water enters a 33,200 gallon detention tank which provides 44 minutes of detention at 750 gpm. Detention is followed by filtration by three (3) 10' x 10' concrete gravity filters. The total design filtration rate is 750 gpm at a unit filtration rate of 2.5 gpm per square foot of filter area. After filtration, clearwell storage is provided by two (2) above ground reservoirs (AquaStore). One is 31' diameter and 42' high and stores 238,000 gallons and the second is 42' in diameter and 42' high and stores 425,000 gallons. Total clearwell storage at the plant is 663,000 gallons. High service pumps at the plant deliver water into the distribution system.

The daily capacity of the plant, based on a 20 hour day at 750 gpm, is 900,000 gallons. A 20 hour day is used to allow time for filter backwash and maintenance activities. During peak usage periods the plant has been operating at a filtration rate of 3.0 gpm per square foot of filter area and a treatment rate of 900 gpm. Daily water use for the Castlewood plant from January of 2009 to July of 2012 is illustrated in Figure 3. In the figure, daily readings are shown in black. Some of the readings are unusually high or low because the totalizer meter was read at a different time of the day as a previous reading or a reading was missed on a weekend resulting in zero gallons for the day and two days of water use for the next day. To account for this, a three day moving average was used to smooth out the graph and show a more representative pattern of water use. The three day moving average is shown in red in Figure 3.

Figure 3 shows the typical pattern of high water use for the summer months and more moderate use during the rest of the year. It also confirms that water use during the hot dry summer of 2012 exceeded the peak day volume of any of the previous years shown in the Figure. Table 5 lists the average day and peak day use experienced at each of the plants and for the two plants combined from 2009 through July of 2012. Both the Castlewood and Sioux plants have experienced their highest peak day use in 2012. The table also shows the ratio between peak and average day. This is also known as the peaking factor. The overall peaking factor is relatively low which indicates fairly uniform water use throughout the year by the system's customers. The higher peaking factor during 2012 is indicative of the hot and dry summer that resulted in high water use for livestock watering and lawn and garden irrigation.

As illustrated in Figure 3 and Table 5 the peak day experienced at the Castlewood WTP has exceeded the design capacity of the plant in 2011 and 2012. The Figure and Table both confirm a rising water use pattern which is expected to continue as the system continues modest growth in customers, the water use patterns of current customers change and factors such as weather patterns affect water use. An increase in the capacity of the Castlewood WTP is therefore recommended.

c. Sioux Plant: The Sioux plant treatment process is the same as the Castlewood plant and utilizes the oxidation of iron and manganese followed by filtration to remove iron and manganese from the raw water supply. The groundwater supply for the Sioux Plant is from wells at the Castlewood well field and delivered to the Sioux Plant by means of approximately 8.5 miles of 10-inch raw water main. Raw water entering the plant passes through a 5' x 5' induced draft aerator with a rated capacity of 750 gpm at 30 gpm per square foot. After aeration the water enters a 13,300 gallon detention tank which was part of the original plant construction. The tank provides 33 minutes of detention at 400 gpm. In a subsequent construction stage a second tank was converted to detention and adds 20,700 gallons for 51 minutes of detention at 400 gpm. Detention is followed by filtration by two (2) 10' x 10' concrete gravity filters. The total design filtration rate is 400 gpm at a unit filtration rate of 2.0 gpm per square foot of filter area. After filtration, clearwell storage is provided by one (1) above ground reservoir (AquaStore), 39' diameter and 38' high and stores 338,000 gallons. High service pumps at the plant deliver water into the distribution system.

The treatment rate of the plant, based on its filtration capacity, is 400 gpm. The daily capacity of the plant, based on a 20 hour day, is 480,000 gallons. A 20 hour day is used to allow time for filter backwash and maintenance activities. During peak usage periods the plant has been operating at a filtration rate of 2.5 gpm per square foot of filter area and a treatment rate of 500 gpm.

Daily water use for the Sioux plant is illustrated in Figure 4. In the figure, daily readings are shown in black. As discussed for the Castlewood plant, because some of the readings are unusually high or low, a three day moving average was used to smooth out the graph and show a more representative pattern of water use. The three day moving average is shown in red in Figure 4.

Figure 4 shows the typical pattern of high water use for the summer months and more moderate use during the rest of the year. It also confirms that water use during the hot dry summer of 2012 exceeded the peak day volume of any of the previous years shown in the Figure. Table 5 lists the average day and peak day use experienced at each of the plants and for the two plants combined from 2009 through July of 2012. Both plants have experienced their highest peak day use in 2012. The table also shows the ratio between

peak and average day. This is also known as the peaking factor. The overall peaking factor is relatively low which indicates fairly uniform water use throughout the year by the system's customers. The higher peaking factor during 2012 is indicative of the hot and dry summer that resulted in high water use for livestock watering and lawn and garden irrigation.

As illustrated in Figure 4 and Table 5 the peak day experienced at the Sioux WTP has approached the design capacity of the plant in 2011 and exceeded it in 2012. The Figure and Table both confirm a rising water use pattern which is expected to continue as the system continues modest growth in customers, the water use patterns of current customers change and factors such as weather patterns affect water use. An increase in the capacity of the Sioux WTP is therefore recommended.

4. Storage:

Water storage for the system is provided by clearwell and ground storage at each plant, ground storage at three sites within the distribution system and five elevated tanks scattered throughout the system's service area. Table 6 provides information of the type and capacity of each of these storage facilities. Storage for the system includes two (2) below grade concrete reservoirs, six (6) bolted steel (Aquastore) tanks and five (5) welded steel elevated tanks. Total finished water storage for the system is 1,906,000 gallons. The minimum level of storage recommended by the Department of Environment and Natural Resources (DENR) for South Dakota is an average day of water use. During 2012 the system's average day water use is projected to be about 1,152,000 gallons and existing storage easily exceeds this amount. In general, storage for the system appears to be adequate and no changes are recommended.

5. Distribution and Pumping:

Since its initial construction from 1974 to 1977 the system has seen continued growth and now provides service to more than twice as many customers as were initially provided service. It has also seen the addition of several community and bulk customers and continued growth in the amount of water used by individual customers. This continued growth has necessitated improvements to the distribution and pumping system in order to add the capacity needed. The distribution system now includes numerous locations where new distribution mains have been added to parallel an original distribution main.

There are a number of areas that are currently experiencing low or marginal pressures, particularly during high usage periods. An additional indication that distribution capacity is limited in some areas is that it is becoming increasingly difficult to deliver water to some of the outlying elevated tanks. The following describes some of the areas of concern.

a. West of the Sioux Plant: Continued growth in the number of customers in this area and particularly close to Pelican Lake have resulted in low pressures on the south side of Pelican Lake and throughout the area west of Pelican Lake and south of Lake Kampeska. Growth in the number of customers is expected to continue in this area. In addition, it is becoming increasingly difficult to deliver an adequate supply to Tower E located south of this area.

b. North of Booster H: Booster H is located north of Kranzburg and is supplied from Tower G. It provides service to an area north of the booster in the northeast part of the Sioux Rural Water service area. The capacity of the booster is limited by undersized pipe suppling the booster and on the discharge side of the booster and low pressure problems are occurring in the area north of the booster.

c. East of Watertown: Currently, Tower G east of Watertown is filled from the Sioux plant by Booster D and increased demands are making it difficult for Booster D to supply the tower. When Booster D is not pumping, Tower G supplies the area north of the Sioux plant and along Interstate 29. Because of the distance and undersized pipe, pressure concerns are increasing in this area. Industrial and commercial development is expected to continue along I-29 and several years ago the system constructed a number of miles of 6" main along this corridor in order to meet the growth needs. The current distribution system is not fully capable of supplying this 6" main and as growth continues, pressure problems will increase.

d. Miscellaneous Locations: There are a number of areas throughout the system that are experiencing localized pressure problems resulting from isolated segments of undersized mains that deplete the residual pressures during peak usage periods. Three areas have been identified as follows:

   1. The Krause Reservoir pumps deliver water into an area south of the reservoir. The first mile south of the reservoir is a 3" main and current demands have resulted in high headloss in this segment and low pressures have resulted south and east of the reservoir.

   2. A localized area north and east of Tower F is experiencing low pressure because of continued growth that has utilized the available capacity in the pipelines serving the area.

   3. A localized area north of Booster C is experiencing low pressure because of continued growth that has utilized the available capacity in the pipelines serving the area.

6. Meters:

The individual customer meters are the "cash register" of the system and are critically important in generating the revenue needed for the operation of the system. All customer uses are metered. Meters originally installed throughout the system are the typical positive displacement type located in a meter pit or basement with a meter head that transmits the reading to a remote read-out above ground adjacent to the meter pit or outside the home on an exterior wall. Sioux has a program of regular inspection and replacement of meters and is currently replacing the older positive displacement meters with Sensus iPerl electromagnetic flow meters. These new technology meters are highly accurate, have no moving parts to wear out, and are designed to interface with Automatic Meter Reading (AMR) systems. At the present time approximately 300 of the newer meters have been installed.

Individual customer meters are read monthly by the customer and a meter reading is sent in with the customer's payment for the water used. On an annual basis Sioux staff or contract laborers manually read all of the meters and compare the readings to those reported by the customer. Self-reading of customer meters is typical of rural water systems because it reduces the amount of manpower required to read the meters individually as is typical in a municipality. While the self-reading method does save manpower, there are a number of disadvantages to this method that result in added cost and a reduced level of management of the system.

Self-reading frequently results in mistakes made in recording the reading, resulting in a bill that is too high or too low. Another result is an inaccurate total water use within a service area. Comparisons of water delivered to a service area, as measured with a master meter, to total water sold for water loss calculations are thus made inaccurate. Also, some customers have been known to "bank" water; whereby they under report use in some months and then make up with a higher reported use in a subsequent month. Since the Sioux has a declining-block rate structure, the customers can put more usage in a block charged at a lower rate, resulting in lower income to the system.

Currently, meter readings are reported monthly. With the time allowed for reporting and the time required to enter and process the readings in the system office, there is a nearly two-month delay from the time water is used to the time accurate comparisons can be made between water delivered to a service area and the water used and sold in that service area. Operational staff therefore have insufficient information at hand to determine on a real-time basis whether increased usage is due to leaks, water theft or to increased customer demand.

C. Financial Status of Existing Facilities

Financial information for Sioux Rural Water is provided in Appendix B. Included in the appendix are the following:

- Current Water Rate Schedule for Sioux Rural Water, effective August 1, 2012
- Sioux Rural Water Audit Report For the Years Ended December 31, 2011 and 2010 by Kinner & Company Ltd, Certified Public Accountant
- Sioux Rural Water System, Inc., RUS Report for the 12 Months Ending December 2011 (includes Annual Budget for Sioux Rural Water for 2011 and actual expenditures for 2011)
- Sioux Rural Water System, Inc., RUS Report for the 12 Months Ending June 30, 2012 (includes Annual Budget for Sioux Rural Water for 2012 and actual expenditures through the end of the period)
- Short Term Capital Improvement Schedule

The Water Rate Schedule adopted by Sioux Rural Water provides appropriate rates for the various user groups served by the system. Rates are modified to reflect the different water usage patterns of each group and their impact on the capacity of the components of the system and the cost of operation and maintenance activities. Revenue generated by these rates is shown in the two RUS Reports. These rates were responsible for 95% of the total income for the system in 2011. During 2011 the percent of water sales revenue received from each major user group was as follows:

Rural Sales	89%
Small Town & Lake Homes	3%
Seasonal	1%
Bulk Purchasers	7%

The majority of the system's customers purchase water under the Farm and Rural Residence rate and a rate card showing the cost for various monthly amounts is included in Appendix B. This rate provides for a monthly minimum payment of $37 and water use is then billed at a cost of $3.60 per 1,000 gallons for the first 65,000 gallons and $2.60 per 1,000 gallons for use over that amount. As shown in the 2011 budget, Rural Sales were budgeted at $1,222,000 and actual revenue was $1,290,781.76. A similar result is shown for the other user group categories for 2011 except for the Bulk Purchasers in which case actual revenue was slightly below budgeted. In general, the water rates established by Sioux Rural water are functioning as planned to secure the revenue needs of the system.

The RUS Reports provided in Appendix B detail budgeted and actual costs for the various O&M activities of the system. Operating costs are broken down into "Administrative", "Office", and "Operational" and additional detail is provided under each category for the various expense categories. The level of detail provided allows adequate monitoring of the expenditures of the system. A review of the reports shows that actual expenses generally correspond to budgeted expenses and result in a positive net income amount.

The system contracts with a qualified Certified Public Accountant to perform an audit of its financial records and prepare an audit report annually. A copy of the audit report for 2010 and 2011 prepared by Kinner & Company Ltd of Brookings, SD is provided in appendix B. Long-term Debt is reported in pages 11 through 14. Through the end of 2011 the outstanding Long Term Debt was $3,859,041. The system budgets for and makes regular debt service payments on this debt and paid $198,132 in interest and total loan payments of $401,172.56 in 2011.

The report also indicates that in 2010 and 2011 the system generated adequate revenues to pay for all expenses including those from operations and the servicing of debt. Net income for 2010 was $53,476.75 and $97,042.37 for 2011. The audit also shows that the system maintains cash reserves totaling $296,752.71 in 2011 as required by USDA Rural Development and CoBank as part of the loan agreements by those agencies. In addition, the report shows that at the end of 2011, the system held cash or cash equivalents of $414,714.22. Together, these assets total $711,466,93 and represent approximately 5.6 months of projected expenses for 2012, which is a significant reserve against unforseen changes in revenue or expenses.

The system's financial planning and monitoring activities center on the budgets included in the RUS Reports. In order to plan and manage expenditures, the system utilizes an annual planning and budgeting process and prepares a budget of projected revenues and expenditures at the beginning of each calendar year. The budget is then monitored monthly by management staff and the Board of Directors. Budgets for 2011 and 2012 are also provided in Appendix B. The budgets confirm that the system utilizes sound financial planning and management procedures and Sioux Rural Water is in excellent financial condition.

NEED FOR PROJECT

A. Health, Sanitation, and Security

The variety of capacity problems with the wells, water treatment, pumping, and distribution system described in the previous paragraphs are jeopardizing the health and safety of the system's customers. Low pressure problems, and in particular, complete depressurizing of distribution mains that will occur if supply and delivery problems are not corrected are particularly troublesome. Low pressure or complete loss of pressure in water mains can allow contaminated ground water surrounding the pipe to enter the distribution system through weak areas and leaks within the many miles of distribution pipeline and is to be avoided at all costs. The health and safety impacts of such an event could be catastrophic.

1. Distribution System Improvements:

Distribution and pumping system limitations that have resulted in areas of low pressure and difficulties in filling outlying reservoirs were described in a previous section. The improvements that are recommended to the distribution system to correct these deficiencies are illustrated in red in Drawing 1 and will be further described in the following paragraphs.

a. West of the Sioux Plant: The improvements to correct the deficiencies in this area include approximately 8 miles of 8" pipe, 1.5 miles of 4" pipe and the connection of two existing pipelines south of Pelican Lake. The 8" pipe segment will both increase the delivery capacity in the low pressure area east of Pelican and south of Kampeska, and increase delivery from the Sioux plant to Tower E. The 4" improvements shown will connect segments of existing main to form a loop and allow flow to high demand areas from two directions. The connection south of Pelican Lake will connect two existing lines, again forming a loop that will make better use of the existing distribution mains in that area. Because the two lines are in different pressure zones, a new pressure reducing valve will be required to prevent the over pressurizing of the lower pressure class main.

b. North of Booster H: The improvements recommended to correct the low pressure area north of the booster are approximately 1.5 miles of new 6" pipe south of the booster that will increase the supply to the booster and approximately 1.5 miles of new 6" pipe north of the booster that would reduce the headloss in these first miles and increase the pressure in the area north of the booster.

c. East of Watertown: Approximately 4 miles of new 6" pipe are proposed immediately west of Tower G. The new pipe would allow increased delivery to Tower G directly from the Sioux plant and increase the capacity in the northeast area of the system, and in particular, the corridor along I-29.

d. Miscellaneous Locations:

(1) Installing one mile of 6" main south of the Krause Reservoir would remove a high headloss segment and increase the pressure to low pressure areas south and east of the reservoir.

(2) The localized pressure problem in the area north and east of Tower F can be corrected by installing approximately 1.5 miles of new 3" pipe that completes a loop and allows delivery to the low pressure area from the existing 5" main north of Tower F.

(3) A localized pressure problem north of Booster C can be corrected by installing approximately 1 miles of 3" main that would complete a loop between two existing mains to allow flow into the low pressure area from another direction.

2. Pumping Improvements:

a. Booster H: Booster H draws suction from the Tower G service area and pressurizes the area to the north of the booster. It was designed with two pumps, each full capacity so that one pump was always available as a backup. Currently it has only one pump and the addition of a backup pump is recommended because the booster's service area is dependent on a pump running at all times. If the "North of Booster H" distribution system

improvements are constructed, a larger pump should be installed to take advantage of the improved hydraulic supply and delivery pipeline and the existing pump used as a backup.

b. Booster D: Booster D was designed to deliver water from the Sioux WTP to Tower G to the north and Tower F to the south. The current operation of the system is to supply Tower F from the Castlewood WTP via the Krause Reservoir and Booster and therefore Booster D pumps only to Tower G. The booster is equipped with two pumps with the Tower F pump kept idle at this time. Our recommendation is to utilize the Tower F as a backup pump to the Tower G pump and add controls to alternate the pumps to pump to Tower G.

c. Sioux WTP High Service Pumps: The plant was originally equipped with four pumps, with two (#3 and #2) regularly pumping east, one regularly pumping west (#4), and the fourth pump (#1) able to pump either direction. Pump #2 was subsequently replaced with a 40 HP full capacity pump and is equipped with a VFD and provides the total supply to the east. Pump #3, a 20 HP pump is not used. Pump #4 has also been replaced with a 40 HP full capacity pump with a VFD and provides all of the pumping needs to the west. Pump #1 remains as originally designed and is equipped with a VFD. It is able to pump east or west if pump #2 or #4 fail, but it is undersized and unable to provide the full needs in either direction. As a consequence, neither of the two pumps supplying the total needs of the system are fully backed up and we therefore recommend changing out Pump #1 with a larger 40 HP pump that can provide the total needs in either direction from the plant and serve as a backup to both #2 and #4. The "West of the Sioux Plant" distribution system improvements will allow the plant to deliver an increased flow to the west but will not significantly change the hydraulic requirements of Pump #4 and no pumping changes are needed because of the distribution improvements. Similarly, the "East of Watertown" distribution improvements will not affect the performance of Pump #2 significantly and no pumping changes are needed because of the distribution system improvements.

d. Castlewood WTP High Service Pumps: The Castlewood WTP has three identical high service pumps with one pumping east to the Krause Reservoir, one pumping west to Kones Corner and the third able to pump in either direction. All of the pumps are appropriately sized and each of the pumps has a backup pump available and therefore no pumping changes are recommended at this time at the Castlewood WTP.

e. Krause Reservoir and Booster: The Krause Booster draws suction from the adjacent reservoir. Two high head pumps alternate to deliver water to Tower F. Two low head pumps deliver water into the distribution system. At times the distribution system demands exceed the flow available from one low head pump and both pumps operate. The pumps are backed up with a pressure regulated connection from the high head side. The current pumps and low head backup system is working well at the booster and no changes are recommended.

f. Kones Corner Reservoir and Booster: The Kones booster draws suction from the reservoir and boosts the flow into distribution with a single constant speed pump. The booster is able to meet the current demands satisfactorily but does not have a backup pump and our recommendation is to add a backup pump in the future to increase the reliability of the booster.

g. Hayti: The Hayti Booster and Reservoir is a modification of an original station that delivered water from wells at Hayti into the distribution system. At the present time, the Hayti reservoir receives water from Booster C and a single, 20 HP pump delivers water to the City of Hayti and operates based on the water level in the City's elevated tank. The re-purposed pump is oversized for the demands and the reservoir is not needed to meet the demands of the City. It is recommended that a second, smaller pump be added in the future to backup the existing pump.

h. Booster C: Booster C has two pumps with one pump filling Tower A and a second filling Tower B. The pumps are not identical but can backup one another. To provide increased reliability a third pump is recommended to backup both of the two current pumps.

3. Source Capacity Improvements:

a. Water Treatment Plant Capacity: As shown in Figures 3 and 4 and Table 5, peak day water demands for recent years has approached or exceeded the design capacity of the two water treatment plants and in particular, during 2012 when there were periods of time when the plants operated almost continuously at a filtration rate greater than their design capacity. The historic combined peak day that occurred in 2012 was 1,651,000 gallons which exceeds the 1,380,000 gpd design capacity of the two plants by 20%. Growth in water demand is expected to continue as additional homes are built in the vicinity of Pelican Lake in the northwest part of the system and larger livestock increase.

As shown by Figures 3 and 4, historic water use exceeded the design capacity of both the Castlewood and Sioux water treatment plants in 2012 and in many of the preceding years. Clearly, capacity improvements are required at both plants.

The primary controlling factor in the treatment rate of both plants is the filtration capacity. The Sioux plant currently has two (2) 10' x 10' gravity filters and the Castlewood plant has three (3) 10' x 10' gravity filters. An expansion in plant capacity will require the addition of new filters. To achieve efficiencies in the layout of the building and simplify the operation of the plant, the new filters should be a duplication of the existing filters.

The addition of each new 10' x 10' filter at the Sioux plant adds 200 gpm or 240,000 gallons per day of capacity. The current plant capacity is 480,000 gallons per day versus the 2012 peak day of 568,333 gallons. The addition

of one filter would increase the plant capacity to 720,000 gallons per day which would exceed the 2012 peak day but leave little room for growth. We therefore recommend adding two filters to bring the plant capacity up to 800 gpm or 960,000 gallons per day.

The addition of each new 10' x 10' filter at the Castlewood plant increases the plant capacity by 250 gpm or 300,000 gallons per day. The addition of one filter would increase the plant capacity to 1,200,000 gallons per day versus the 2012 peak day of 1,113,000 gallons. As with the Sioux plant, the addition of one filter would increase the plant capacity to be greater than the historic peak day but leave very little room for growth. We therefore recommend adding two filters at Castlewood to bring the plant capacity up to 1,250 gpm or 1,500,000 gallons per day.

Added filtration capacity at each plant will also require a corresponding increase in detention capacity to maintain adequate detention time. Approximately 60 minutes of detention time is needed to provide adequate treatment. The Sioux WTP was built with 13,300 gallons of detention and later, 20,700 gallons more were added by converting a clearwell to detention. After aeration, water enters the 20,700 converted clearwell and is then pumped to the 13,300 gallon tank. Only one pump is used to transfer the water between the two tanks and therefore, mechanical failure of this single pump will jeopardize the operation of the entire plant. Pumping of water during the detention step is also a concern because any oxidized iron and manganese particles that have agglomerated to form a floc are broken up as they pass through the pump. It is therefore recommended that the converted clearwell detention tank be abandoned and approximately 34,700 gallons of new detention be added. With the original 13,300 gallons of detention, this would result in a total of 48,000 gallons and 60 minutes of detention at 800 gpm.

The Castlewood plant currently has a 33,200 gallon detention tank which provides 44 minutes of detention at the 750 design treatment rate of the plant. The addition of two new filters would increase the treatment rate to 1,250 gpm and would require a total of 90,000 gallons of detention to achieve a detention time of 60 minutes. A consideration of possible piping and plant layout alternatives has concluded that it will be more efficient to build all new detention of 90,000 gallons and discontinue use of the existing detention tank. The existing detention would remain available for emergency use or during times that the new detention tank is taken out of service for cleaning or other maintenance needs.

b. Well Capacity: A total of six (6) wells are available in the Castlewood well field and supply both plants. Total well capacity is 1,830 gpm and firm capacity (capacity with the largest well out of service) is 1,385 gpm. The combined peak day that occurred in 2012 was 1,651,000 gallons. To provide the historic peak day, firm well capacity should be approximately 1,375 gpm to provide the peak day needs over a 20 hour period. Thus, the current wells are capable of meeting the historic peak day needs.

As noted in the previous section, proposed capacity improvements would result in 800 gpm in treatment capacity at Sioux and 1,250 gpm at Castlewood for a total of 2,050 gpm. To match treatment capacity, additional wells are required and to do so, 220 gpm of new well capacity would result in total capacity of 2,050 gpm and 665 gpm of new well capacity would result in firm capacity of 2,050. It is therefore recommended that at least two new wells be added as part of a capacity improvement project. Two new wells, depending on their capacity, would add from 500 to 700 gpm of new capacity to the system.

B System O & M

1. Mapping and Hydraulic Model:

The system utilizes mapping of its distribution system to identify the location of existing facilities when performing routine maintenance activities, trouble shooting events such as leaks or interruptions of service, providing utility locates for contractors and other utilities as they perform excavation activities in the vicinity of its pipeline, and a variety of other uses. The system's mapping is also necessary for planning activities and provides a visual reference when considering future improvements, such as service to new customers or providing additional capacity to current customers. Because of its multiple uses, mapping is a critical tool in the operation and management of the system.

Two general levels of mapping are maintained by the system. An overall distribution system map shows the location, size, and pressure class of all mainline pipe. It also shows the location of mainline valves, customers, pumping stations, storage reservoirs, and water source facilities. In addition, detail mapping referred to as "staking sheets" is also maintained. Staking sheets covering an approximate area of one square mile show in more detail the location of mainline pipe, service lines, services line valves and the location of individual customers. Staking sheets are printed on an aerial photography background.

All of the mapping components are in digital form and maintained by the system's engineering firm. Periodic updates are made to incorporate changes such as new customers that have been added and other changes in the facilities of the system. In order to adequately plan and describe the improvements needed for this study, current mapping is required and will be updated as part of this project.

A second vital tool in the operation of the system is a current hydraulic model. The system's engineer maintains this model and utilizes it to advise the system on the impact of adding new customers and other questions periodically throughout each year. The model is very robust. It utilizes KYPipe software and is able to simulate the operation of the pumping, storage, and distribution facilities in a variety of water use scenarios. As is the case with mapping, a current and accurate model is needed to identify weaknesses in the distribution and pumping system and provide the analysis needed to consider improvement alternatives proposed as part of the current study. The hydraulic model needs to be updated as it presently does not include all of the current customers and current water use throughout the system. As part of the

updating process, all new customers and changes in the facilities of the system will be added to the model and the model will be calibrated using current water use data and pressure recordings from various parts of the system. The data was gathered during the high water use period of the summer of 2012 when many of the components of the system were stressed and at the limit of their capacity.

2. AMR System:

The existing customer read meter and billing system results in a loss of revenue and inefficiencies in the management of water loss. An Automatic Meter Reading (AMR) system will accurately read and store customer and master meter readings and promptly generate accurate and consistent customer bills with a minimum of time and effort on the part of system staff. Such systems are ideally suited for rural water systems such as Sioux that cover large areas which make reading customer meters individually a costly and time consuming endeavor. It has been estimated that it would require approximately 200 or more additional man hours monthly to read each meter individually. The estimated cost, at $30 per man hour (with taxes and fringe benefits) would be $6,000 monthly, or about $72,000 annually.

The system is proposing to replace its existing meters with a Fixed Based AMR system. This type of system utilizes a fixed base tower or towers that communicates by radio to each individual meter. The data collected is processed by the host computer and the data is stored and used to generate and archive monthly bills that are sent out to each customer. The meters and software proposed also allow each individual meter to record water use data over an extended period of time which can be used to analyze unusual water use events and individual large water user data that can be used to more accurately model the hydraulics of the system. All of the meters in a service area are read at the same time and compared to the reading of a master meter to provide real-time data for water loss analysis and leak detection.

The components of the system include the replacement of all of the older style meters, the addition of a meter head on all meters that communicates with the fixed base tower, three fixed base radio towers, 2 radio boosters, and the computer equipment and software to process the data and generate bills.

C. Growth:

The capacity limitations described in paragraph A "Health, Sanitation, and Security" have occurred over time as system demands have increased both because of new customers and increased water use by existing customers. Each of the measures recommended to correct the current capacity limitations will add a modest amount of new excess capacity that will permit the continued addition of new customers and allow the system to develop in a planned and financially feasible manner.

ALTERNATES CONSIDERED

A. The Do Nothing Alternative

No action is one alternative considered. The proposed improvements are designed to meet expected increases in water demand. The water system could elect not to make the improvements. The result of no action would be a need to restrict growth of water demand, whether by restricting the addition of new consumers, by instituting water restrictions, or both. Sioux Rural Water is the only regional source of water for this area, so restrictions would force area residents to individual water supplies. Historically, individual supplies in the area are prone to contamination and have poor water quality. If no action is taken and demand is allowed to increase, there will be times of dangerously low water pressure, or service outages, with the present system. Sioux Rural Water has a relatively high water rate, and it is unlikely that voluntary water conservation would have a significant impact.

B. Source Improvement Alternatives

The two plants, Castlewood and Sioux, were constructed at the same time to remove iron and manganese and chlorinate the water from wells located adjacent to each plant. Because of nitrate contamination, the system later abandoned the wells at the Sioux plant and built a raw water main from the Castlewood well field to the Sioux plant. Both plants now utilize the Castlewood well field. For this reason, we will consider two alternative ways to increase the treated water capacity for the system.

1. Alternative #1 - Expand Both Plants and Add Wells at Castlewood

a. Description: This alternative would build two new wells at the Castlewood well field and expand the detention and filtration capacity of both plants. All of the wells would pump to the Castlewood plant and aeration for both plants would take place at Castlewood. New transfer pumps at Castlewood would deliver aerated water to the Sioux plant through the existing raw water main and the treatment process would be completed at Sioux.

The Castlewood plant capacity improvements in addition to the new aeration capacity needed for both plants would include a new detention tank and two new filters. The existing aeration and detention facilities at Castlewood would be retained for emergency use and during the cleaning of the new detention tank. The Sioux plant capacity improvements would be similar to Castlewood, adding additional detention and filtration capacity.

The capacity improvements proposed would result in the following:

Current Well Field Capacity:	1,830 gpm
Additional Capacity Proposed	500 gpm
Total Capacity with New Wells	2,330 gpm
Firm Capacity with New Wells	1,885 gpm

Current Castlewood WTP Capacity	750 gpm
Additional Capacity Proposed	500 gpm
Total Capacity with Addition	1,250 gpm
Current Sioux WTP Capacity	400 gpm
Additional Capacity Proposed	400 gpm
Total Capacity with Addition	800 gpm
Total Capacity - Both Plants	2,050 gpm

b. Design Criteria

(1) Aeration: Induced draft, 30 gpm per square foot
Castlewood Plant only, approx. 70 sq. ft.
Transfer pumps to Sioux - 800 gpm

(2) Detention: 60 minutes
Castlewood - 1,250 gpm, 75,000 gallons new
Sioux - 800 gpm, 48,000 gallons

(3) Filtration:
Castlewood, 2.5 gpm/sq. ft.
1,250 gpm, 500 sq. ft., 200 sq. ft. new
Sioux, 2.0 gpm/sq.ft.
800 gpm, 400 sq. ft., 200 sq. ft. new

c. Drawings: Drawings A1.1 through A1.4 show the improvements proposed as part of Alternative #1. A1.1 shows a proposed site plan for the Sioux plant expansion and the new facilities are shown in more detail in A1.2. The site plan and detail drawing for the Castlewood plant are shown in A1.3 and A1.4 respectively.

d. Environmental Impacts: There are no significant environmental impacts expected for this alternative.

e. Land Requirements: Sioux Rural Water has entered into a purchase agreement for a new well site south of the Castlewood plant which will be the location of one of the two wells that have been proposed. The second well will be located within the boundaries of the land owned by Sioux surrounding the current wells. Adequate space on the existing WTP sites is available for the proposed plant expansions.

f. Construction Problems: No unusual construction problems are anticipated.

g. Cost Estimates: Table 9 provides an estimated construction cost for the addition of two new wells at Castlewood and raw water main to connect the wells to existing raw water main and to the Castlewood plant. Table 10 provides an estimated cost for the Alternative 1 improvements.

h. Advantages/Disadvantages:

(1) The two plants have operated satisfactorily in the past and are understood by operating personnel. Expanding both plants therefore will not require any changes or new operator training.

(2) The capital cost to expand both plants is less than the cost of a single new plant.

(3) A project that expands both plants will encourage planners to consider updating and keeping current other components of the plants to allow them to serve well into the future. If a single new plant is built, components of the existing Castlewood plant will eventually become outdated and need a renewal investment.

2. Alternative #2 - New Plant at Castlewood and Add Wells at Castlewood

a. Description: This alternative would discontinue treatment at the Sioux plant and build all new capacity at Castlewood. The new capacity at Castlewood would be built as a completely new, stand alone plant on the same site as the existing plant. The existing Castlewood plant would continue to be utilized. Treated water from the Castlewood plant would be pumped to the Sioux plant through the existing raw water main where it would be repumped into the distribution system. Because the filtration rate at the existing Castlewood plant is higher than at the Sioux plant (2.5 gpm/sq. ft. vs. 2.0 gpm/ sq. ft., building all new filtration capacity at Castlewood can be done more efficiently.

The capacity improvements proposed would result in the following:

Current Well Field Capacity:	1,830 gpm
Additional Capacity Proposed	500 gpm
Total Capacity with New Wells	2,330 gpm
Firm Capacity with New Wells	1,885 gpm

Current Castlewood WTP Capacity	750 gpm
New Castlewood Plant Capacity	1,300 gpm
Total Capacity with Addition	2,050 gpm

b. Design Criteria:

(1) Aeration: Induced draft, 30 gpm per square foot
New Castlewood Plant only, 1,300 gpm, approx. 43 sq. ft.

(2) Detention: 60 minutes
New Castlewood Plant only, 78,000 gallons new

(3) Filtration:
New Castlewood Plant only, 2.5 gpm/sq. ft.
1,300 gpm, 520 sq. ft., 4 12' x 12' filters

c. Drawings: Drawings A2-1 through A2-5 show the site plan and basic layout of the building proposed for the new Castlewood plant option.

d. Environmental Impacts: There are no significant environmental impacts expected for this alternative.

e. Land Requirements: Sioux Rural Water has entered into a purchase agreement for a new well site south of the Castlewood plant which will be the location of one of the two wells that have been proposed. The second well will be located within the boundaries of the land owned by Sioux surrounding the current wells. Adequate space is available on the existing Castlewood WTP site for the proposed new plant.

f. Construction Problems: No unusual construction problems are anticipated.

g. Cost Estimates: Table 9 provides an estimated construction cost for the addition of two new wells at Castlewood and raw water main to connect the wells to existing raw water main and to the Castlewood plant. Table 10 provides an estimated cost for the Alternative 2 improvements.

h. Advantages/Disadvantages:

(1) A savings in operation and maintenance costs will be achieved if a single new plant is built. All treatment would occur at the Castlewood site, reducing effort and travel by operators between the two sites. Also, less net filtration area in this alternative will reduce the future cost of filter media replacement. Another consideration is that raw water would no longer be pumped approximately 8 miles to the Sioux plant and instead treated water would be pumped through the existing raw water main, reducing the effort needed to periodically clean this line by pigging.

(2) Building a single new building rather than adding on and renovating two older buildings will reduce the unknown cost factors during the planning process.

(3) Building a new plant provides the opportunity to incorporate the newest technological advances and provide the flexibility needed to adapt to continuing changes in the regulatory area.

(4) All of the treatment close to the Castlewood well field will allow for greater flexibility and redundancy in the use of the wells. Because of hydraulic considerations, the wells are currently equipped with pumps that allow them to be used either at the Sioux plant or the Castlewood plant. With changes to the pumps on the Sioux wells, all of the wells could be used to pump to the Castlewood plants.

SELECTION OF AN ALTERNATIVE

A. Cost Comparison

Table 11 provides a life cycle cost comparison of the two alternatives. It converts the construction cost for each Alternative to an annual debt service cost based on an interest rate and term for typical funding from USDA Rural Development. Differences in Annual Operating Costs are also included in the table and together, the various costs calculate the annual cost of each alternative. The table indicates that Alternative #1 is significantly less costly than Alternative #2.

B. Other Factors

Non-quantifiable factors generally favor the Alternative #2. A new plant at Castlewood would be modern, state-of-the-art facility and all treatment would occur at the new plant and the adjacent existing Castlewood WTP allowing operators to more conveniently operate both plants.

C. Selection

The cost advantage of Alternative #1, expanding both plants are too significant to out weigh the advantages of Alternate #2 and we will therefore select Alternative #1 as the preferred alternative.

PROPOSED PROJECT

A. Project Description

1. AMR System:

The components for a complete Fixed Base AMR System are listed in Table 7; however, the AMR system is <u>NOT</u> part of the proposed project as other items have greater urgency.

2. Distribution System Improvements:

Distribution system improvements are proposed as detailed in Table 8.

3. Pumping Improvements:

Pumping improvements are detailed in Table 8. The <u>Owner</u> intends to perform the work as associated with the pumping improvements outside of the proposed project.

4. Well Field Improvements:

The addition of two new wells, as shown in Table 9, is proposed for either of the two treatment alternatives considered.

5. Water Treatment Plant Improvements

The Alternative #1 Improvements, as shown in Tables 10 and 11, are proposed that include expansion of both plants.

B. Total Project Cost Estimate

A complete cost estimate for the proposed project, including non-construction costs is provided in Table 12.

C. Annual Operating Budget

Changes to the Operating Budget are displayed in Table 13. The second column of the table shows the amounts for the current Sioux RW operating budget, the third column shows changes to the budget if the proposed project is constructed, the fourth column shows the percentage increase in the current budget that would occur with the increases shown in the third column, and finally, the fifth column displays the operating budget totals with the changes that would occur if the project was built.

1. Income

Income would need to increase by about 17% to cover the costs of the project. In order to generate the increased revenue, the water rate will need to be increased. Table 13 shows a proportional increase to each of the water sales categories, however, an actual rate increase might impact each category differently depending on the desires of the Sioux RW management and Board.

2. O&M Costs

It is anticipated that the project will not significantly impact present operation and maintenance costs. The only impact shown is a reduction in Contracted Services for annual meter reading costs that would no longer be required if the AMR system is built.

3. Debt Repayment

Table 13 shows the changes to RUS loan payments as a result of the project. The loan repayment is based on securing RUS loan funds for the total project cost for Phase 1 shown in Table 12 at an interest rate of 2.75% for 40 years.

4. Reserves

a. Debt Service Reserves

Debt Service Reserve is included in the budget at 10% of the loan payment amount. This would comply with current RUS requirements.

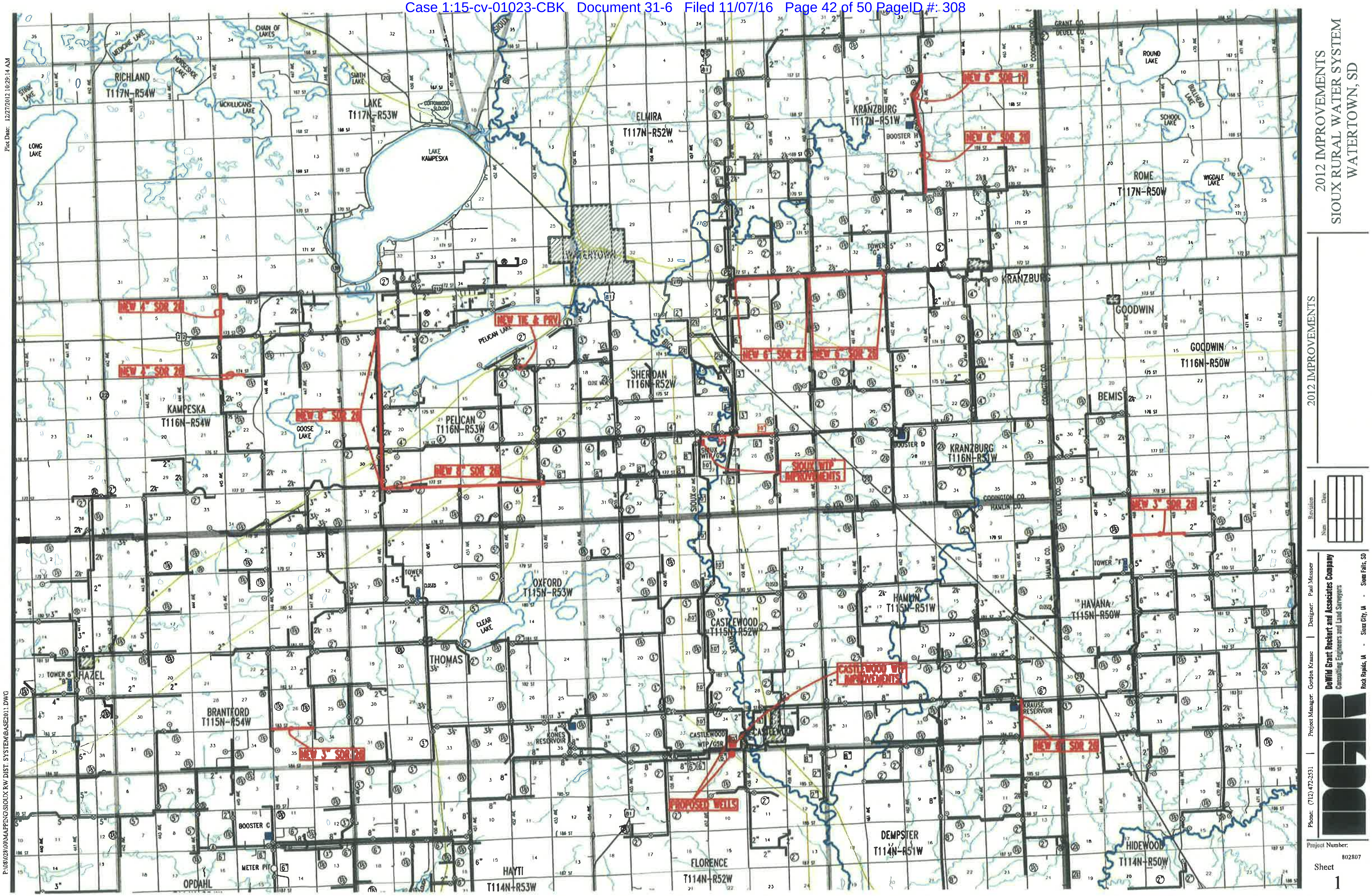
b. Short-lived Asset Reserve

Table 14 shows the calculation of the annualized cost to periodically replace the items listed in the table and the amount was added to the system's existing reserve budget in Table 12.

CONCLUSIONS AND RECOMMENDATIONS

It is our opinion that the project as proposed is both necessary and financially feasible and we therefore encourage Sioux Rural Water to proceed with securing the necessary funding for the project and proceeding to design and construction.

DRAWINGS


2012 IMPROVEMENTS
SIOUX RURAL WATER SYSTEM
WATERTOWN, SD
2012 IMPROVEMENTS
DeWild Grant Reckert and Associates Company
Consulting Engineers and Land Surveyors
Rock Rapids, IA - Sioux City, IA - Sioux Falls, SD
Phone: (712) 472-2531
Project Manager: Gordon Krause
Designer: Paul Messner
Project Number: 802807
Sheet 1
Plot Date: 12/27/2012 10:29:14 AM
NEW 6" SDR 17
NEW 6" SDR 26
NEW 4" SDR 26
NEW TIE & PRV
NEW 6" SDR 26
NEW 8" SDR 26
SIOUX WTP IMPROVEMENTS
NEW 3" SDR 26
CASTLEWOOD WTP IMPROVEMENTS
NEW 3" SDR 26
PROPOSED WELLS
RICHLAND T117N-R54W
LAKE T117N-R53W
ELMIRA T117N-R52W
KRANZBURG T117N-R51W
ROME T117N-R50W
LAKE KAMPESKA
WATERTOWN
KRANZBURG
GOODWIN
GOODWIN T116N-R50W
KAMPESKA T116N-R54W
PELICAN T116N-R53W
SHERIDAN T116N-R52W
KRANZBURG T116N-R51W
BEMIS
PELICAN LAKE
GOOSE LAKE
LONG LAKE
ROUND LAKE
SCHOOL LAKE
OXFORD T115N-R53W
CASTLEWOOD T115N-R52W
HAMLIN T115N-R51W
HAVANA T115N-R50W
CLEAR LAKE
THOMAS
HAZEL
BRANTFORD T115N-R54W
CASTLEWOOD
KRAUSE RESERVOIR
BOOSTER C
BOOSTER D
METER PIT
OPDAHL
HAYTI T114N-R53W
FLORENCE T114N-R52W
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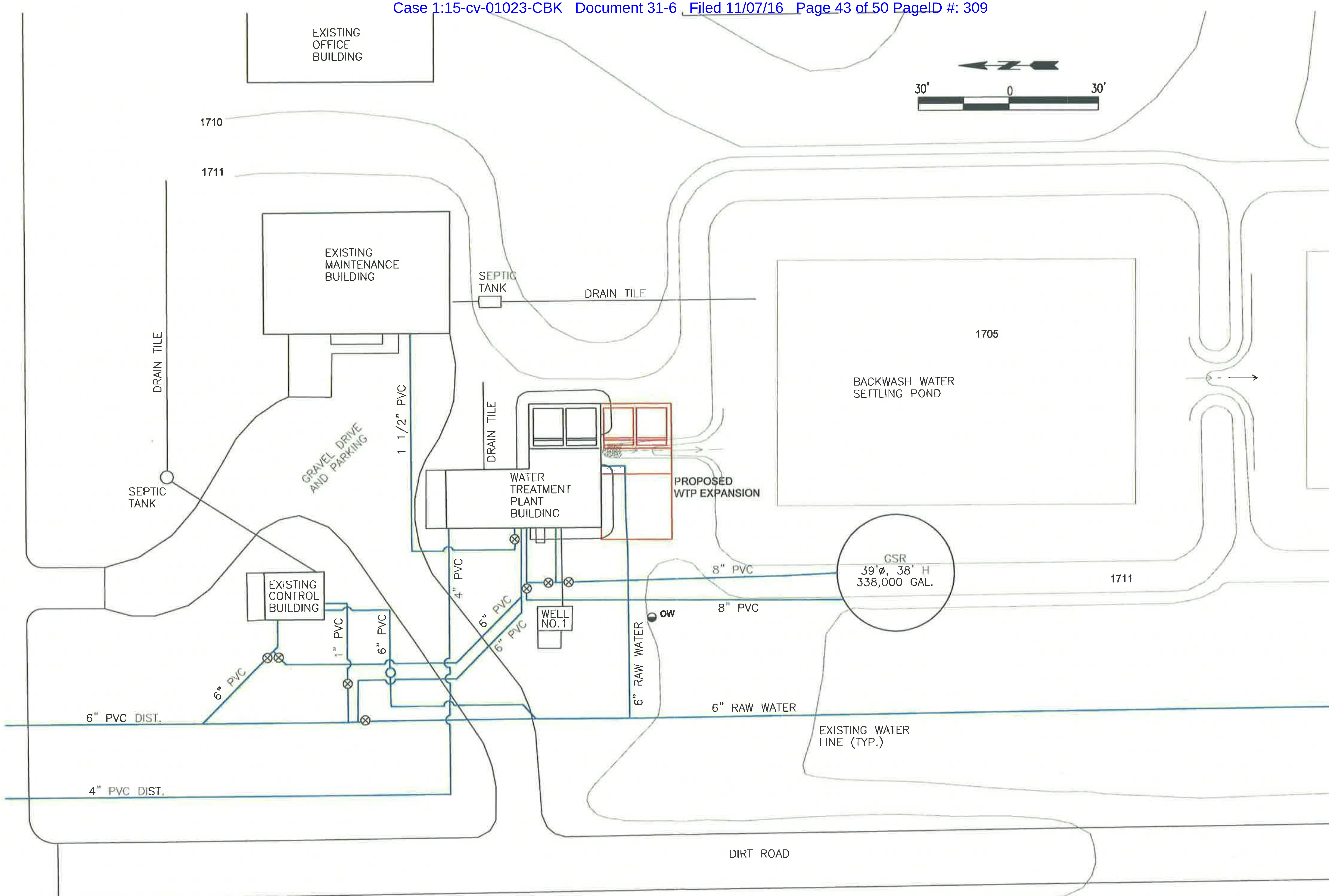
CODINGTON CO.
HAMLIN CO.
DEUEL CO.
GRANT CO.
SIOUX RIVER



ALTERNATIVE #1 - EXPAND SIOUX & CASTLEWOOD WTP'S

2012 WATER SYSTEM IMPROVEMETNS
SIOUX RURAL WATER SYSTEM
WATERTOWN, SOUTH DAKOTA

SIOUX WTP SITE PLAN

Revision | Num | Date

Project Manager: Darin Schriever | Designer: Justin Groen | Phone: (712) 472-2531

DeWild Grant Reckert and Associates Company
Consulting Engineers and Land Surveyors
Rock Rapids, IA - Sioux City, IA - Sioux Falls, SD

DGR

Project Number: 802807

Sheet A1.1

Plot Date: 12/27/2012 10:35:10 AM

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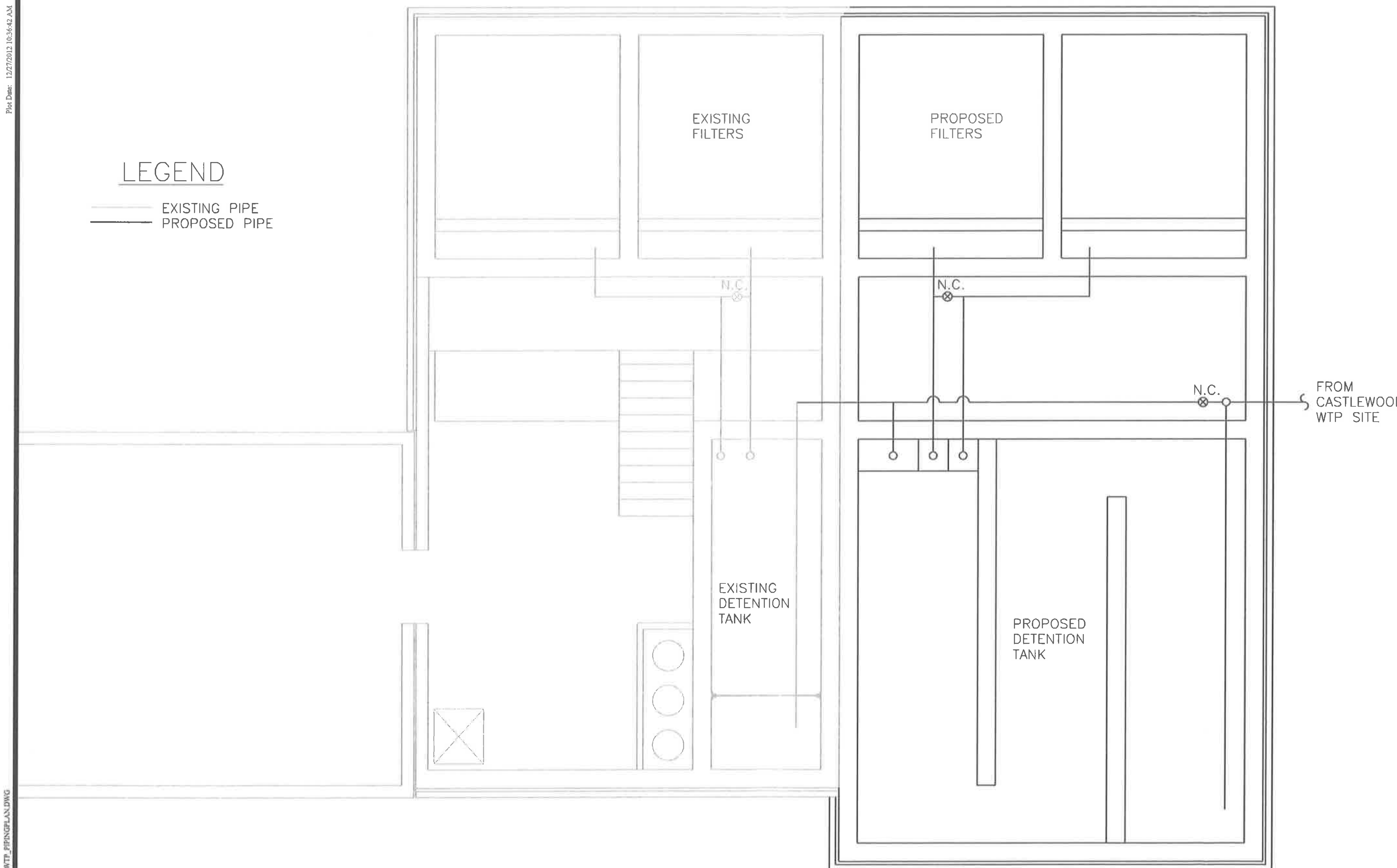
LEGEND

EXISTING PIPE
PROPOSED PIPE



ALTERNATIVE #1 - EXPAND SIOUX & CASTLEWOOD WTP'S

SCALE 3/16"=1'-0"

2012 WATER SYSTEM
IMPROVEMETNS
SIOUX RURAL WATER SYSTEM
WATERTOWN, SOUTH DAKOTA

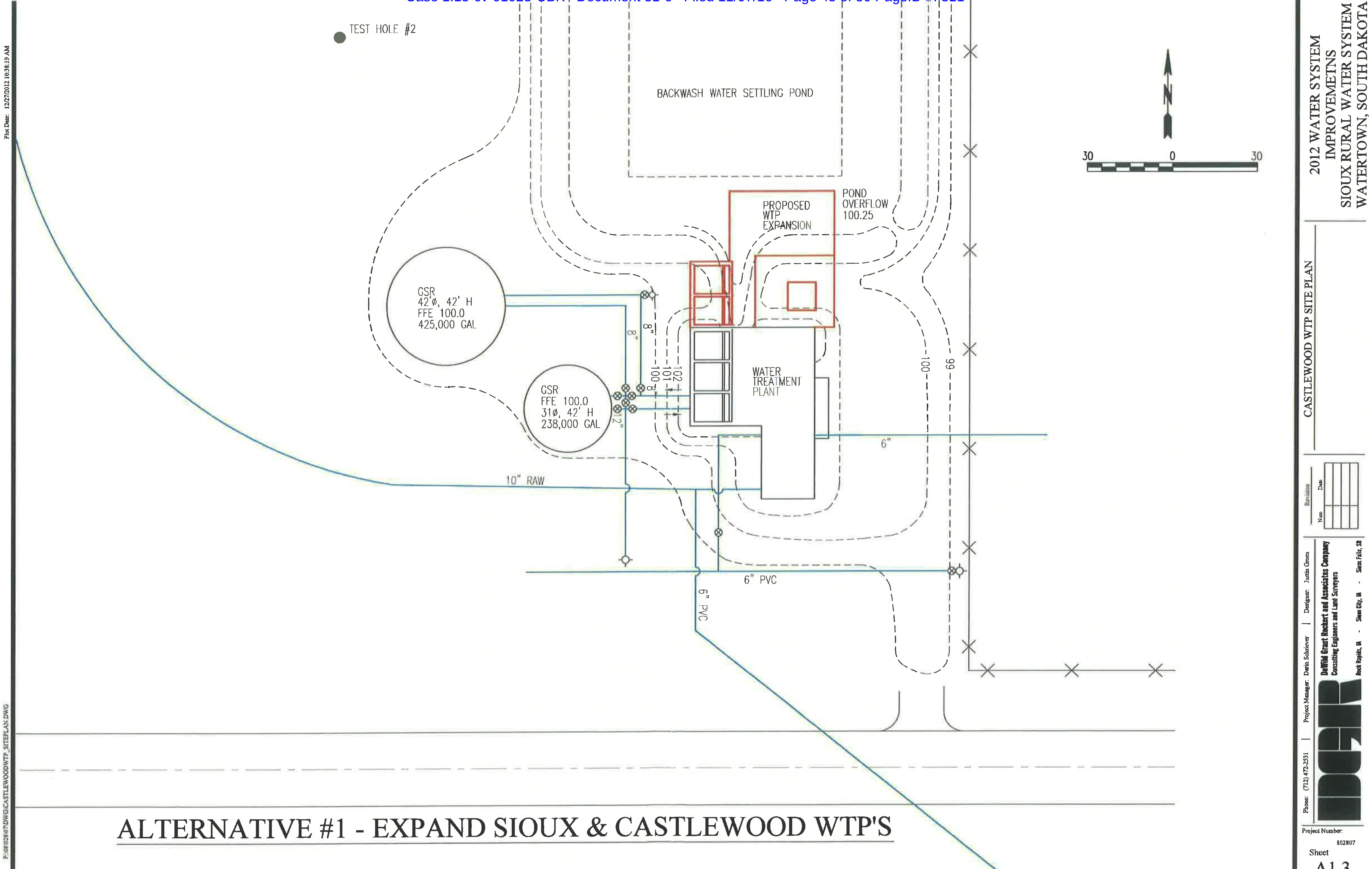
SIOUX WTP FLOOR PLAN

DeWild Grant Reckert and Associates Company
Consulting Engineers and Land Surveyors
Rock Rapids, IA - Sioux City, IA - Sioux Falls, SD

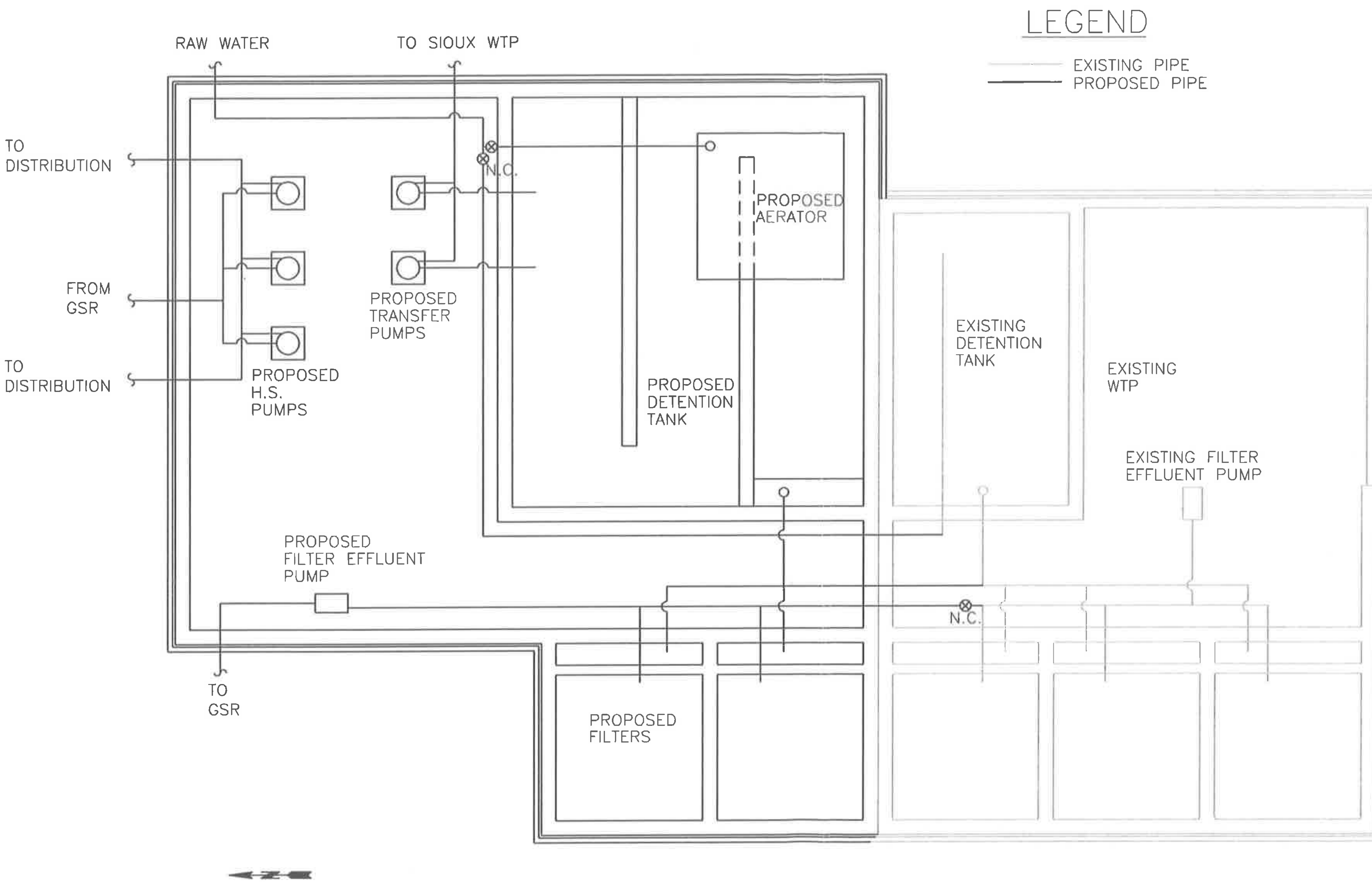
Phone: (712) 472-2531 | Project Manager: Darin Schriever | Designer: Justin Groen

Project Number: 802807

Sheet A1.2



ALTERNATIVE #1 - EXPAND SIOUX & CASTLEWOOD WTP'S



ALTERNATIVE #1-EXPAND SIOUX & CASTLEWOOD WTP'S

SCALE 1/8"=1'-0"

2012 WATER SYSTEM IMPROVEMETNS
SIOUX RURAL WATER SYSTEM
WATERTOWN, SOUTH DAKOTA

CASTLEWOOD WTP FLOOR PLAN

Revision | Num | Date

DeWild Grant Reckert and Associates Company
Consulting Engineers and Land Surveyors
Rock Rapids, IA - Sioux City, IA - Sioux Falls, SD

Phone: (712) 472-2531 | Project Manager: Darin Schriever | Designer: Justin Green

Project Number: 802807

Sheet A1.4

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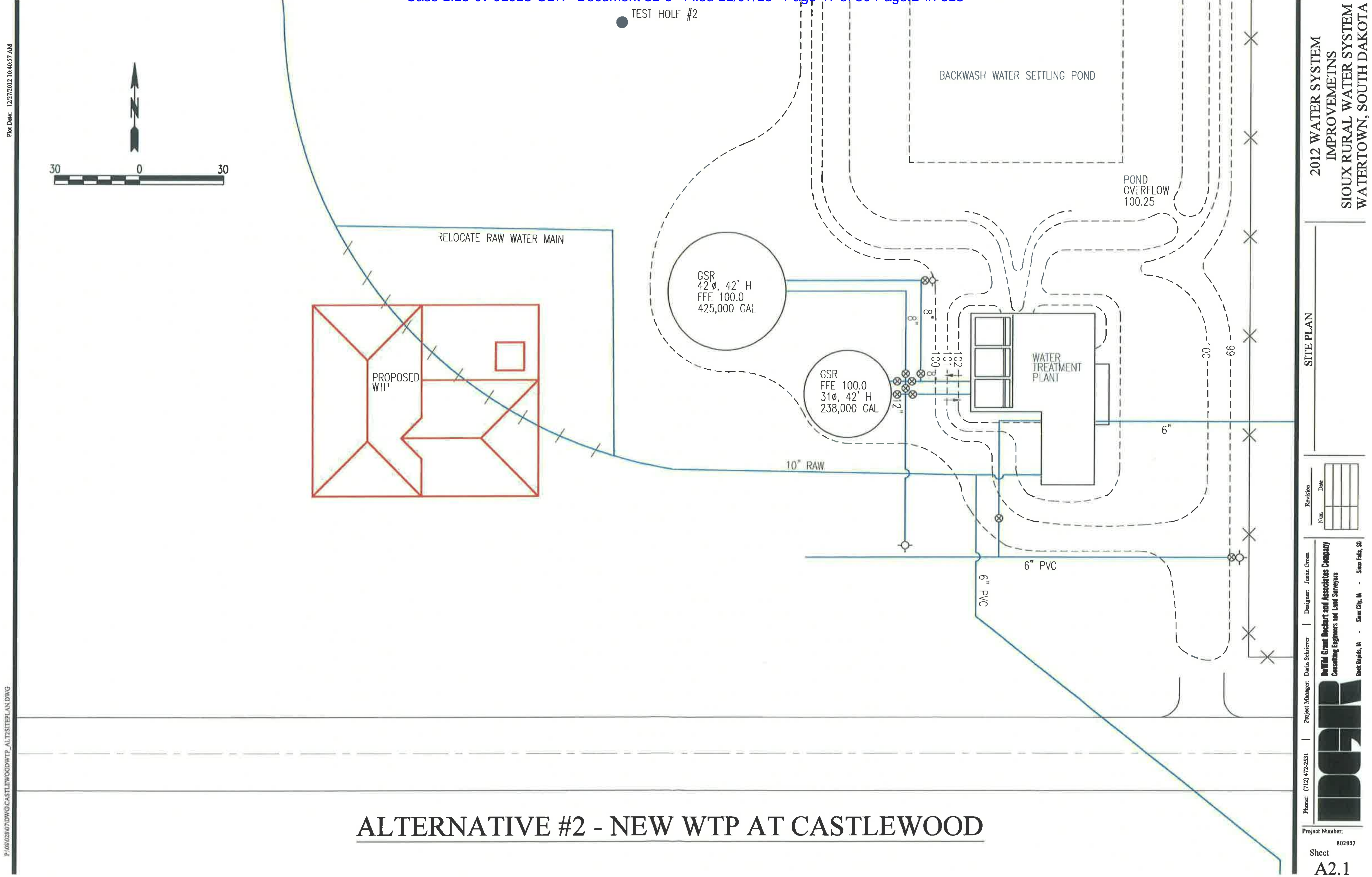
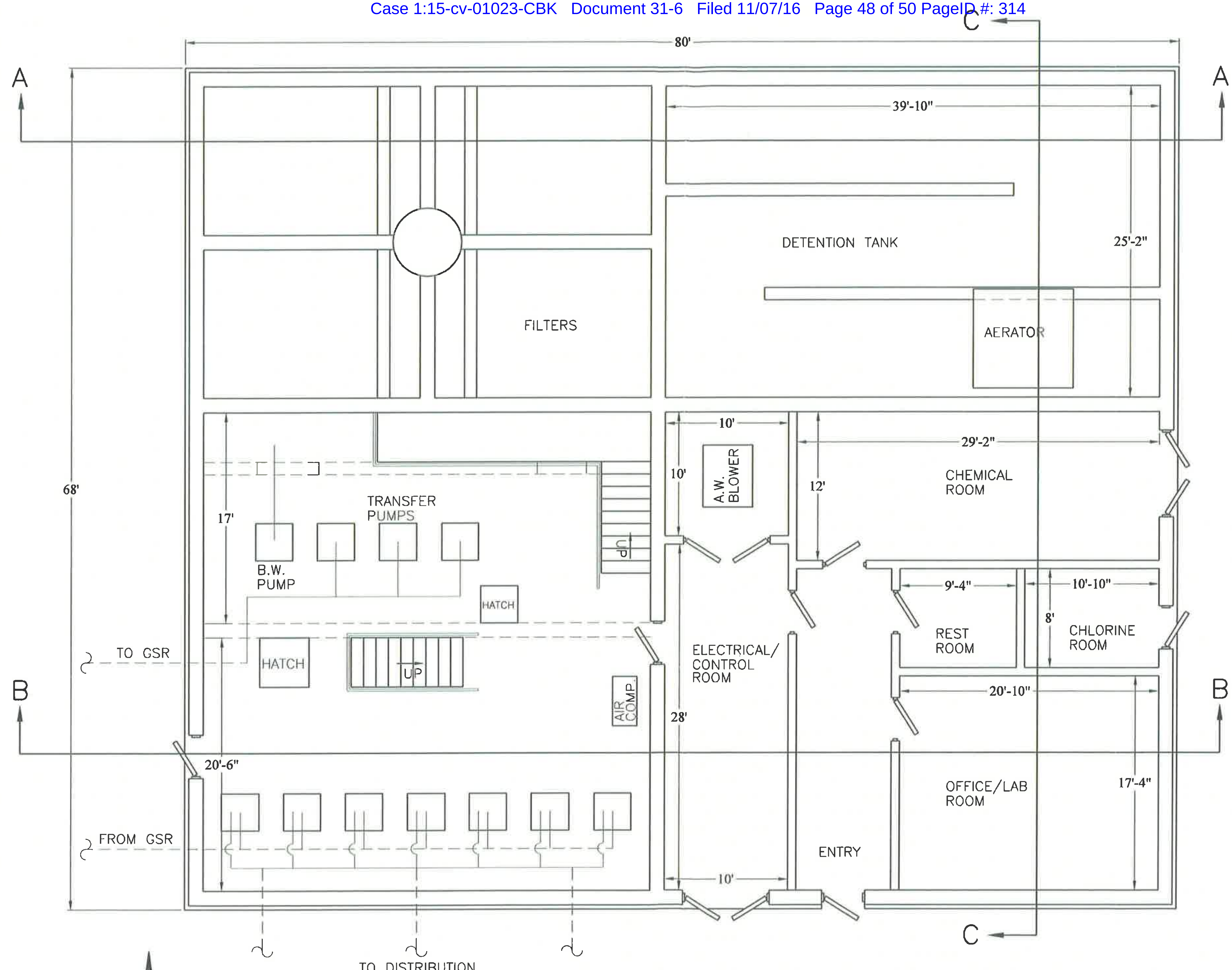


ALTERNATIVE #2 - NEW WTP AT CASTLEWOOD



ALTERNATIVE #2 - NEW WTP AT CASTELWOOD

SCALE 1/8"=1'-0"

2012 WATER SYSTEM IMPROVEMETNS
SIOUX RURAL WATER SYSTEM
WATERTOWN, SOUTH DAKOTA

FLOOR PLAN

Revision | Num | Date

Phone: (712) 472-2531 | Project Manager: Darin Schriever | Designer: Justin Groen

DeWild Grant Reckert and Associates Company
Consulting Engineers and Land Surveyors
Rock Rapids, IA - Sioux City, IA - Sioux Falls, SD

Project Number: 802807

Sheet A2.2

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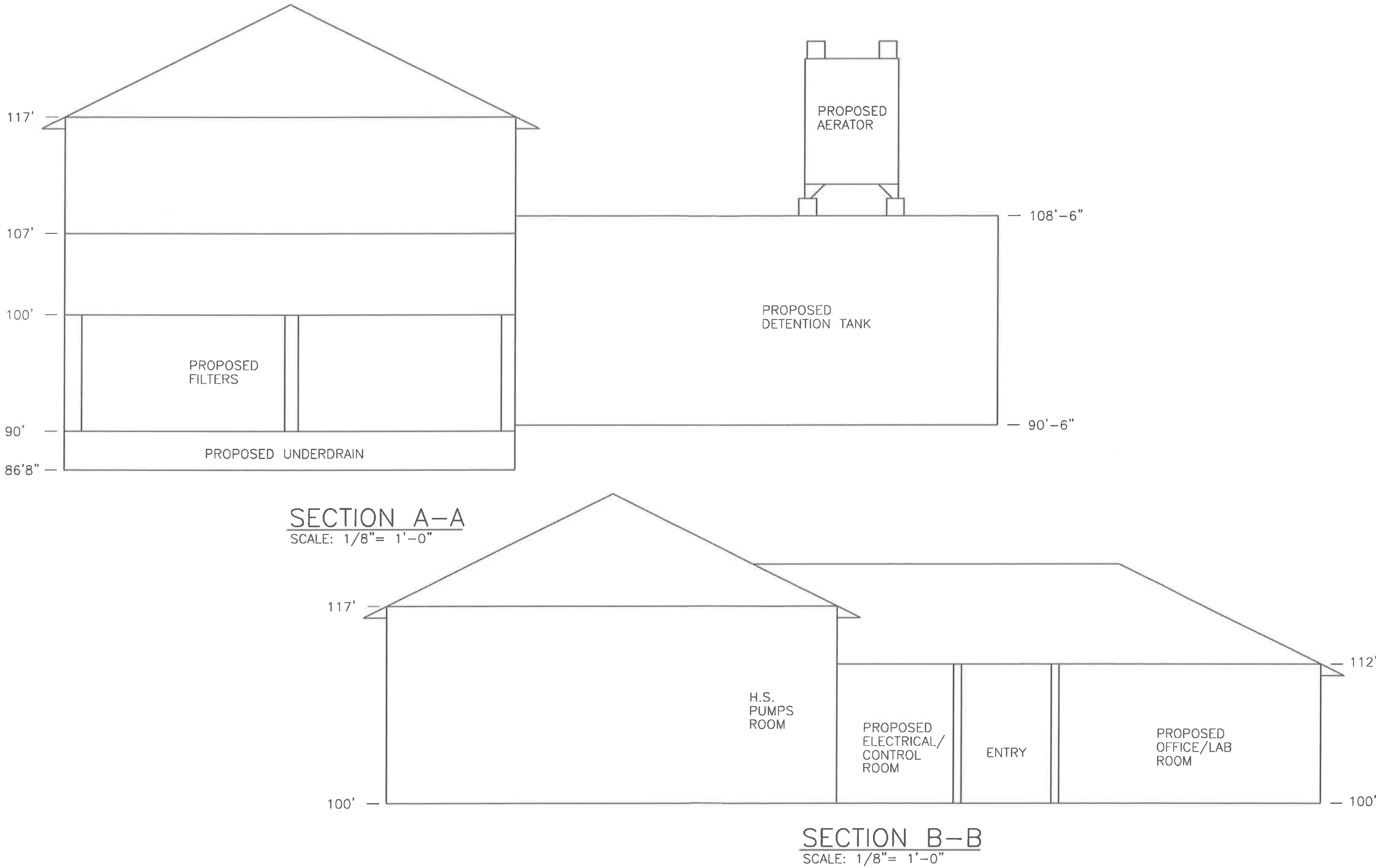


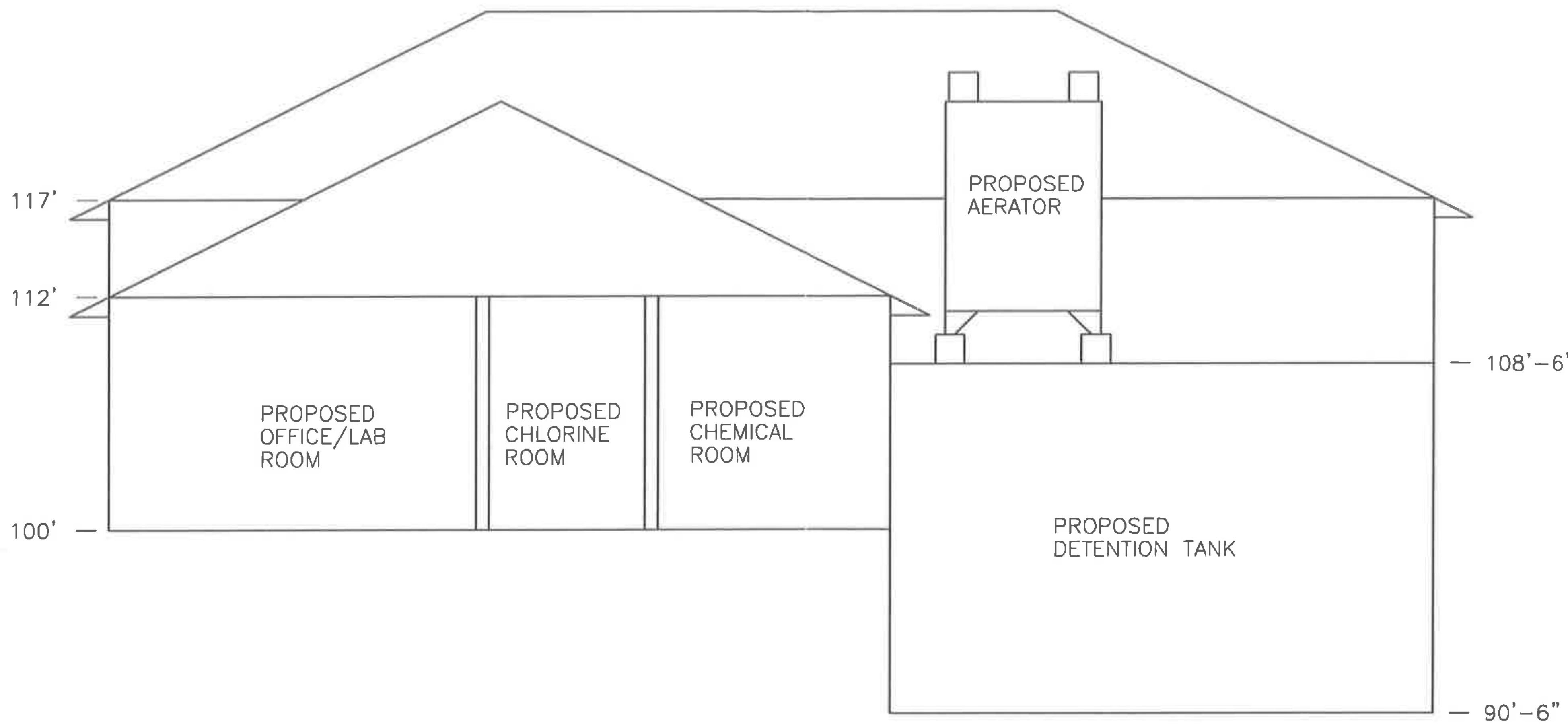
ALTERNATIVE #2 - NEW WTP AT CASTELWOOD

2012 WATER SYSTEM IMPROVEMETNS
SIOUX RURAL WATER SYSTEM
WATERTOWN, SOUTH DAKOTA

SECTIONS

Project Number: 802807

Sheet A2.3



SECTION C-C
SCALE: 1/8"= 1'-0"

ALTERNATIVE #2 - NEW WTP AT CASTELWOOD

2012 WATER SYSTEM IMPROVEMEITNS
SIOUX RURAL WATER SYSTEM
WATERTOWN, SOUTH DAKOTA

SECTIONS

Revision | Num | Date

Phone: (712) 472-2531 | Project Manager: Darin Schriever | Designer: Justin Groen

DeWild Grant Reckert and Associates Company
Consulting Engineers and Land Surveyors
Rock Rapids, IA - Sioux City, IA - Sioux Falls, SD

Project Number, 802807
Sheet A2.4

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